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A new universe for a new world: The colonial American's knowledge of science.

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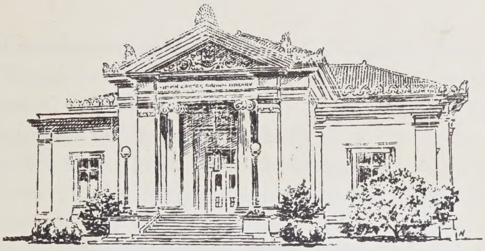

John Carter Brown Library

Brown University ~ Providence, R. I.

A NEW UNIVERSE
FOR
A NEW WORLD:

The Colonial American's Knowledge of Science

An Exhibition opened April 10, 1959 on the
Occasion of the Annual Meeting of the
Associates of the John Carter Brown Library

EARLY AMERICAN NATURAL HISTORY

1. Gonzalo Fernández de Oviedo y Valdés. La Historia General de las Indias. Seville, 1535.

The earliest official attempt to organize the many reports received in Europe of the natural phenomena found in the New World is to be found in this book by the official Chronicler of the Indies. Oviedo was present at the court of Spain when Columbus was received by Ferdinand and Isabella in 1493 after his return from the voyage of discovery. Between 1514 and 1556, Oviedo crossed the Atlantic at least twelve times to carry out his various official duties which included, in addition to being official historian, the Governorship of Carthagena and supervising the gold smeltings in Santo Domingo. Although it is a general description of the Spanish colonies, the many rude woodcuts are almost all devoted to animals and plants. The volume is opened to a picture of an American Manati or sea cow, an aquatic mammal that sailors sometimes identified as a mermaid.

2. Francisco Hernández. De Materia Medica Nova Hispania Philippi Secundi Hispaniarum ac Indiarum. (Abridged by Recchi, manuscript of about 1590.)

3. Hernández. Quatro Libros de la Naturaleza, y Virtudes de las plantas, y animales que estan receuidas en el uso de Medicina en la Nueva España. Mexico, 1615.

The story of the first book on plants published in the New World is embodied in these two volumes. Hernández was sent to Mexico in 1570 to study the medical discoveries of the New World. His manuscript, of twenty volumes, was brought back to Spain where it remained unpublished. Later Nardo Antonio Recchi was ordered to edit the work and extract the medical information. The manuscript shown here is believed to be Recchi's original holograph. It was not until 1615 that Francisco Ximénez in Mexico obtained a copy of Recchi's manuscript, re-edited it, and published the printed book shown here. In 1671 there occurred a fire in the monastery where Hernández's original was kept and from that time forward it was assumed that this great compendium of natural history had been lost. However, within the last year, a copy of the great Hernández manuscript has been discovered in Spain.

4. Nicolás Monardes. Dos Libros. El uno trata de todas las cosas q̃ traẽ de nr̃as Indias Occidẽtales, que sirven al uso de Medicina. Seville, 1565.

The man who played the most important role in assembling facts about the exciting new plants that were being discovered in America never crossed the Atlantic Ocean. He was Dr. Nicolás Monardes of Seville. The story is told that he waited on the dock to receive

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seeds and plants from the Indies. High hopes were held for the great curative powers of certain American plants, and Monardes set about to cultivate them. The result of his labor was the first truly American pharmacopoeia. A very few of his cures, notably quinine, proved to be of real medical value. Others, however, such as chocolate have also been put to use by mankind. The acquisition of this copy of the first part of the book by the Library in 1929 brought the existence of the first edition to light. The second part, of which the Library also owns a copy, was printed in 1571. Before the end of the century, the work went through seventeen editions in four languages: Spanish, Latin, Italian, and English.

5. Pierre Peña and Matthias de Lobel. Stirpium Adversaria Nova. London, 1571.

Perhaps no other botanical discovery in the New World has stirred up so much controversy as the one that has been called variously the "filthy weed" and the "holy herb". The first mention of tobacco is to be found in Amerigo Vespucci's account of his trip to America in 1499 in which he tells of seeing Indians chew it. The first use of the term, a picture of what purports to be a leaf of it, and a description of how it was smoked are to be found in Oviedo's La Historia of 1535 shown earlier. Botanically, however, there remained a good deal of uncertainty about the some fifty different varieties, many of which were of no commercial importance. It was not until the publication of this herbal that the plant that makes up the bulk of today's tobacco, Nicotiana tabacum or Virginia tobacco, was separately described and illustrated. The book is opened to that illustration.

6. Samuel de Champlain. Brief discours Des Choses Plus Remarquables. . . Aux Indes Occidentalles. (Autograph manuscript of about 1601.)

Before his celebrated pioneer voyages to New France, Champlain took a trip to New Spain. He traveled as a tourist for he was visiting a country in which colonization had been going on for a hundred years. He kept a concise journal of his trip, the original of which is shown here. For present purposes, the most important parts of this manuscript are the sixty-two carefully drawn and colored illustrations, of which thirty-four are devoted to pictures of plants and animals. Champlain was not immune to fanciful tales (he includes a dragon), but in the main he drew things as he saw them. On the left is the plantain, a kind of coarse banana that is cooked before eating. On the right is his rendition of the maize or Indian corn, an American plant with which Champlain, in later years, was to become more familiar.

7. William Piso and Georg Marggraf. Historia Naturalis Brasiliae. Leiden, 1648.

This is the most important work on the natural history of Brazil to have been produced in the seventeenth century. The first part by William Piso, a Dutch physician, is called "Medicina Brasiliensi" and is generally regarded as a pioneer work on tropical medicine.

The second part by Georg Marggraf, called "Historiae Rerum Naturalium Brasiliae", is an excellent and systematic account of plants, fish, birds, reptiles, insects, and Indians of Brazil. The large-scale drawings throughout the book are particularly valuable.

8. Thomas Hariot. A Briefe and True Report of the New Found Land of Virginia. Frankfurt am Main, 1590.

This celebrated description of the Roanoke Colony, by a man who accompanied the first settlers, was a promotion tract. From the point of view of early natural science, it is particularly important because most of Hariot's description is devoted to the plants, animals, and other natural resources of the country. The first edition of this book appeared in London in 1588, but without illustration. The particular virtue of this second edition is the inclusion of the engravings from some of the pictures drawn by John White, Hariot's companion. The German publisher chose to engrave only those drawings that showed the Indian way of life. In addition to these, White executed a large number of pictures of birds, animals, fish, and reptiles, all delicately colored. Fortunately most of his work was preserved and the originals may be seen in the British Museum. The book is opened to an engraving of his drawing of Indians fishing, to which have been added, from the other drawings, some examples of sea life.

9. Joseph de Acosta. De Natura Novi Orbis. Salamanca, 1589.

This account of the New World was written by a Jesuit who lived for fifteen years in Peru. Acosta was one of the first writers to discuss seriously the many questions in natural history raised by the discovery of new lands, peoples, plants, and animals. The impact of the book is suggested by the fact that from this first edition it went, in the next century, through some seventeen editions and was translated into six languages.

10. Gabriel Sagard. Le Grand Voyage du Pays des Hurons. Paris, 1632.

We have chosen this book to represent the works of three different authors who, taken together, present the fullest account of New France as the white man found it. The first are the various books of Samuel de Champlain from his Des Sauvages of 1604 to his Les Voyages of 1632. The second is Marc Lescarbot's Histoire de la Nouvelle France of 1609 and the third one is the book shown here. All three--Champlain, Lescarbot, and Sagard--came to America for different reasons. Champlain was a man of action, Lescarbot was a poet, and Sagard was a lay brother in the Recollects, one of the branches of the Franciscan Order.

11. François du Creux. Historiae Canadensis seu Novae-Franciae. Paris, 1664.

"The Jesuit Relations" are regarded by historians as a source without peer for accounts of the interior of Canada during the mid-seventeenth century. These year by year reports of the French Jesuit missionaries were published by the Order annually from 1632 to 1673. However, their dissemination outside France was limited. Thus about 1643, the Order instructed

one of its most learned members, Father François du Creux, to compile and translate into Latin an account drawn from the "Relations." This book is the result. It covers only the earlier years. It is opened to a plate showing a European artist's conception of a beaver dam.

12. Roger Williams. A Key into the Language of America. London, 1643.

Here we have an example of a book which definitely was not written as a contribution to natural science, but which today holds an important place among the records which have come down to us of the state of nature as first seen by the white man. Roger William's purpose in composing the work was to facilitate the conversion of the Indians. He had studied their customs and language at first hand, and during his voyage to England in 1643 to obtain a charter for his colony he set these observations down. It is a great deal more than a phrase book, for interspersed throughout are observations about Indian habits and practices. Indeed, it is a key to Indian culture and, as such, in the modern sense, is an anthropological treatise.

13. Adriaen Van der Donck. Beschryvinge Van Nieuw-Nederlant. Amsterdam, 1655.

This book is a description of one of the new colonies, New Netherland, written to attract settlers and to satisfy European curiosity about America. It necessarily dealt largely with the raw nature of the New World. The author was a Dutch lawyer who made his home in New Amsterdam in 1643, where he served the Van Rensselaer interests.

14. John Josselyn. New England's Rarities Discovered: In Birds, Beasts, Fishes, Serpents and Plants of that Country. London, 1672.

In this volume is to be found the first systematic account of the botanical species of New England. The author has divided the things he saw into six groups: birds, beasts, fishes, serpents and insects, plants, and minerals. A special point is made of separating the plants into those that are indigenous to America and those that are not.

AGE OF NEWTON

15. Samuel Danforth. An Astronomical Description of the late Comet or Blazing-Star. London, 1666.

Modern science is generally regarded as having come to flower toward the end of the seventeenth century. Sometimes the writing of history gives the impression that this great new framework for mankind burst into being through the genius of a few dedicated men. Actually, the development came at the end of a long period during which men's minds were prepared for the great task of reconciliation between divine power behind the forces of nature and the mechanistic explanation of their operation. The book shown here illustrates New England's early participation in this struggle in men's minds. Samuel Danforth, a graduate of Harvard in 1643, was deeply devoted to the tenets of Puritanism. The appearance of a comet in 1664 resulted in this little pamphlet. Danforth filled seventeen pages with detailed observations in the best accepted scientific manner. However, the last ten pages are devoted to a divine explanation of the phenomenon concluding that comets "commonly. . . preced if not portend great Calamities." Its first publication in 1665 in Cambridge, Massachusetts, was followed by this London edition.

16. Increase Mather. Heaven's Alarm to the World. Boston, 1682.

17. Increase Mather. . . . A Discourse Concerning Comets. Boston, 1683.

As in so many other things the Mathers took the lead in New England's participation in the development of the New Science. The first areas of knowledge to develop were astronomy and mathematics. The celestial implications of these fields of investigation were obvious for this family of theologians. The two books shown here are part of the elder Mather's contribution to the large body of early American literature on comets. Heaven's Alarm is his first contribution and is simply an exhortation on God's meaning of a comet that appeared in 1680. In A Discourse Concerning Comets, he enters upon a learned discussion of the true meaning of these heavenly bodies. Dismissing men like Kepler and Bacon, he asserts that their true meaning is to be found in the droughts, tempests, epidemics, and similar calamities.

18. Isaac Newton. Philosophiae Naturalis Principia Mathematica. London, 1687.

The monumental importance of this book in the history of mankind is familiar to all of us. It is the touchstone of Modern Science. Its American significance, however, is not as well known. On the page shown, Newton praises "the observer of New England" for his data on the comet of 1680 which helped in proving that comets traveled in paths determined by gravity. That observer was a native-born American, Thomas Brattle, a graduate of Harvard in 1676 and its treasurer from 1693 to 1713, and a highly successful Boston merchant. This comet is symbolic of the changing American attitude toward science for it is the same one that called forth Increase Mather's two pamphlets.

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19. Cotton Mather. Thoughts for the Day of Rain. Boston, 1712.

The most important American to recognize that the new physics had opened a new world for mankind was Cotton Mather. In this tract, he alluded directly for the first time to Sir Isaac Newton and to the magnitude of his work. He embraced it for the guidance provided for all men who seek to understand God through reason.

20. Cotton Mather. The Christian Philosopher. A Collection of the Best Discoveries in Nature. London, 1721.

This is regarded as the first general survey of science written by an American. It is not, however, purely a scientific book for Mather stated his purpose to be to "demonstrate that Philosophy (that is Science) is no Enemy, but a mighty and wondrous Incentive to Religion." In effect, he complied, from many sources, a compendium which leaves for us an excellent picture of what learned America understood about science at the turn of the century.

21. Cotton Mather. Manuductio ad Ministerium. Directions for a Candidate of the Ministry. Boston, 1726.

This must always be taken with Mather's Christian Philosopher if we are to understand fully his feeling toward science. The primary purpose of this book was to serve as a guide for training ministers and a handbook for composing sermons. However, the belief that a minister must be a man well acquainted with learning of all kinds led Mather here to face directly the conflict between religion and science. His answer was that "Experimental Philosophy" had a place in Christian theology so long as it was regulated, and it was Isaac Newton whose divinely inspired laws provide that regulation.

22. Isaac Greenwood. A Philosophical Discourse Concerning the Mutability and Changes of the Material World. Boston, 1731.

Mathematics and Natural Philosophy went hand in hand in understanding the new developments in science. The importance of such an understanding in the education of youth was recognized at Harvard. In 1727 Thomas Hollis, a London merchant, endowed the Hollis Professorship of Mathematics and of Natural and Experimental Philosophy, the second oldest endowed chair in the country. (He had also endowed the oldest, the Hollis Professorship of Divinity.) With the endowment Hollis presented the college with a collection of almost sixty "Mathematical and Mechanical Instruments." The pamphlet shown here is a discourse delivered by the first holder of the Hollisian Professorship on the occasion of the death of Thomas Hollis.

23. Isaac Greenwood. Arithmetick Vulgar and Decimal. Boston, 1729.

The first Hollisian Professor of Mathematics and Natural and Experimental Philosophy was Isaac Greenwood. He graduated from Harvard in 1721 and began to study for the ministry

under Cotton Mather. However, he soon left for England where he applied himself to mathematics and natural philosophy under John T. Desaguliers, mingled with the members of the Royal Society, and met its president, Sir Isaac Newton. It was during this period that Greenwood caught the attention of Thomas Hollis, and it was to him that Hollis first proposed the creation of the professorship in 1725. He returned to Massachusetts in 1726 and took up the new chair in the following year. He served for a decade, during which he wrote this book. It is the first arithmetic written in the English colonies.

24. John Winthrop. "A Letter from Mr. John Winthrop, Hollisian Professor... concerning the Transit of Mercury... and... an Eclipse of the Moon..." In Philosophical Transactions, Vol. XLII, London, (The Royal Society), 1744.

Greenwood's successor was John Winthrop who, with Mather and Franklin, was one of the three major figures in pre-revolutionary American science. Furthermore, he was the only one of the three who was a professional scientist. After a brilliant career as an undergraduate at Harvard, he was installed as the Hollisian Professor at the age of twenty-five. Shown here is the first of his eleven communications to the Royal Society, with whose foundation in 1660, the beginning of England's scientific eminence is associated. When in 1765 Winthrop was elected to membership, he became a symbol of the ties between the colonies and the Society. Not only was he the thirty-first American to be admitted but he was also the third bearer of his name so honored. The first was his great-granduncle, the first governor of the Connecticut Colony, who in turn was the first American member, having been elected in 1662. The second was a distant cousin from Connecticut who had been elected in 1733. Thus, not only were Americans a part of England's scientific tradition from the beginning, but so was an American family.

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25. John Winthrop. A Lecture on Earthquakes. Boston, 1755.

Winthrop's stature is based as much on the kind of man he was as it is on his work as a scientist. From the beginning of his almost forty-year career of teaching and research he insisted upon dealing with problems on the basis of observation and reason. The pamphlet shown here was the occasion for one of the few public disputes he had with the older tradition which explained natural phenomena in purely theological terms. The earthquake described here was the first one in the British colonies to be studied in purely scientific terms. Winthrop took this opportunity to attack the older concepts of the relation between God and the Universe and asserted that earthquakes were caused solely by the structure of the Earth. For years Puritans had been using these upheavals as inspiration for sermons warning of the vengeance of God. A New England earthquake in 1727 had produced twenty-six such sermons, and this one called forth about a dozen.

26. John Winthrop. Two Lectures on Comets. Boston, 1759.

Comets and their characteristics were probably the most popular astronomical phenomenon among New England scientists, and the story is told that Winthrop suspended classes when-

ever one appeared. Edmund Halley, the Astronomer Royal, had predicted at the time of its periodic appearance in 1680 that the comet that bears his name would reappear in 1757. As the predicted date approached the scientific world waited in high anticipation. Although it was 618 days late public interest mounted. The final appearance of the comet produced these two public lectures by Winthrop.

27. John Winthrop. Relation of a Voyage from Boston to Newfoundland for the Observation of the Transit of Venus. Boston, 1761.

Perhaps the most notable event of Winthrop's scientific career was the expedition he led to Newfoundland to observe the transit of Venus across the sun in 1761. It was the first completely American scientific expedition. The passages of Venus between the earth and the sun occur in pairs, eight years apart, at intervals of more than one hundred years. From a close observation of the parallax (the angle between the center of the sun and Venus at mid-point in transit), it was possible to determine the actual distance from the earth to the sun. Until that time the distance of the various planets had been expressed in relative terms only. The government of Massachusetts thought it was important enough to finance the trip. The pamphlet shown here is Winthrop's account of the expedition.

28. Cadwallader Colden. An Explication of the First Causes of Action in Matter and of the Cause of Gravitation. New York, 1745.

The first American to attempt to improve on Newton was Cadwallader Colden, who, like his friend Franklin, indulged a wide variety of interests. As lieutenant-governor of New York he had broad administrative experience, but he was also a philosopher, doctor, and scientist. In the little book shown here he offers his improvements over the Newtonian basis of mechanics, and the book is often called the first American work of pure science. It was so abstruse that it was little noticed in this country, but apparently it was read in London, where it was reprinted the following year.

29. Theophilus Grew. The Description and Use of the Globes. Germantown, 1753.

Interest in natural philosophy extended to other colonial colleges. This book is a guide to the use of philosophical apparatus for the students of the College of Philadelphia, now the University of Pennsylvania. The author was the first professor of mathematics at that college.

30. Nehemiah Strong. Astronomy Improved. New Haven, 1784.

This is a textbook intended for the use of Yale College in which are embodied the Newtonian concepts of gravitation as they operate in the planetary system. The author makes no mention of Newton and refers the origin of the law of gravitation to God. It has been suggested that Strong had to be particularly careful in his treatment of the subject even at this comparatively late date because of the strong theological domination of the college curriculum.

AGE OF LINNAEUS

31. John Clayton. Flora Virginica. Leydon, 1762.

This is the first flora of Virginia. The author, the clerk of Gloucester County, Virginia, and an avid naturalist, continually communicated his observations to European and British correspondents. Among them were Linnaeus and John Frederick Gronovius. It was the latter who gathered Clayton's work together and published it in Leyden in 1739. The book was revised once in 1743 and again for this edition of 1762. Although the Library owns all three editions, we have chosen to show this one because it contains the map showing the extent of Clayton's travels.

32. Peter Kalm. En Resa Til Norra America. Stockholm, 1753-1761, 3v.

This book is the product of the first government-sponsored botanical expedition to North America. The Swedish government sent Peter Kalm, one of Linnaeus' pupils, to America to find new plants and trees which could be raised in Sweden. He arrived in Philadelphia in 1748 and in the ensuing two and a half years visited all the middle British colonies and southern Canada. This publication of his journal proved to be a great deal more than a mere compilation of botanical observations. It is one of the most delightful accounts of Pennsylvania, New York, and New Jersey as they were in the middle of the century. Kalm literally talked about everything. In addition to his accounts of plants there were descriptions of animals, buildings, religion, disease, machinery, and Indians. His acute powers of observation coupled with a pleasing literary style have left us in debt to this Swedish botanist.

33. John Ellis. Directions for Bringing Over Seeds and Plants. London, 1770.

We have here the first published description and picture of one of the most unusual plants found in North America. It is an insect-eating flower. The open sections at the ends of the leaves close when an insect enters and the plant proceeds to digest its prey. A dead specimen was sent to England by John Bartram. Some years later another Philadelphian, William Young, sent a living plant to John Ellis, a Fellow of the Royal Society, who made a careful description of it for Linnaeus. That communication was printed in the proceedings of the Royal Society of Sweden in 1773. However, three years earlier, Ellis had published this fuller account in English as an appendix to his directions for shipping live plants on an ocean voyage.

34. John Bartram. Observations on the Inhabitants, Climate, Soil, Rivers, Productions, Animals, and other matters worthy of Notice. . . In Canada. London, 1751.

35. William Stork. A description of East-Florida, with a journal, Kept by John Bartram of Philadelphia. The Third Edition, London, 1769.

An important by-product of Logan's association with Linnaeus was his introduction of John Bartram to the Swedish botanist. Bartram was to American botany what Winthrop was to American astronomy. He was our first native-born professional botanical scientist, and in 1765 he was appointed Botanist to the King. Although he never left America, the letters he wrote and the plants he sent to England and Europe introduced colonial botany to the western world. Linnaeus called him the greatest "natural botanist" in the world, and his delightful home and garden on the banks of the Schuylkill became a natural stopping place for distinguished visitors to Philadelphia. Shown here are Bartram's two principal books. The first is an account of a botanical journey into the west taken in 1743 and the second, which is appended to the third edition of Stork's account of East-Florida, is Bartram's account of his journey of 1765 and 1766 into the Carolinas and Florida.

36. James Logan. Experiments et Meletemata de Plantarum Generatione. Leyden, 1739.

The connection between America and the Linnaean classification of plants, based on their sexual differences, is surprisingly close. As early as 1716, Cotton Mather had reported his observations on cross-pollination in some of his neighbor's corn to the Royal Society. Unfortunately this work received little circulation, and it was the book shown here that first brought American participation in this branch of botany to the attention of Linnaeus. James Logan was the most important figure in Pennsylvania during the first half of the eighteenth century. He has been called a Quaker virtuoso (a gentleman scholar) and was one of the two or three most learned colonial Americans. In 1727 he conducted a controlled experiment with the tassels of corn. Linnaeus praised Logan's work extravagantly, and it was published with the aid of J. F. Gronovius, who helped with Clayton's book. This first Latin edition was followed six years later by a translation into English that was printed in London.

37. Mark Catesby. The Natural History of Carolina, Florida and the Bahama Islands. London, 1731-1748.

Mark Catesby has been called the founder of American ornithology. Between 1712 and 1726, he made two trips to America and spent more than ten years studying the wild life of the southern colonies and the West Indies. Upon his return to England he began the preparation of this great work which was published in three parts between 1731 and 1748. The first consists of one hundred plates of American birds, each one pictured with the characteristic vegetation of its environment. Catesby inaugurated this technique which was later copied by many of his successors, most notably Audubon. The second and third parts of the book are devoted to beasts, fishes, serpents, insects, and plants. Its popularity was such that it went through revised editions in 1754 and 1771, and certain parts of it were published in German.

AGE OF FRANKLIN

38. Benjamin Franklin. Experiments and Observations on Electricity. London, 1751-1754.

For us, as for his contemporaries, Benjamin Franklin symbolizes American participation in the great scientific developments of the eighteenth century. The colonies produced both better scientists and men more deeply interested in the new universe that was unfolding, but no American embraced so completely the multitude of interests with which the science of the "enlightenment" is associated. The book shown here is the one which established Franklin's international reputation. It is also his most enduring contribution, for he was the first to describe electricity as matter composed of positive and negative particles. Franklin's observations were sent as thirteen letters to Peter Collinson in London, who, in turn, published them in three parts between 1751 and 1754. The book went through five English, one German, and three French editions in Franklin's lifetime.

39. Ebenezer Kinnersley. . . . A Course of Experiments on the Newly-discovered Electric Fire. (Newport, 1752).

Benjamin Franklin did not conduct his electrical experiments all by himself. He was assisted by a number of fellow Philadelphians. The most notable of them was Ebenezer Kinnersley. Indeed, Kinnersley's contribution to American participation in electrical experiments was second only to Franklin's, a fact which Franklin himself generously acknowledged. Shown here is the only known copy of a broadside announcing a course of lectures given by Kinnersley in Newport in March, 1752. Electrical demonstrations became a very popular form of public entertainment.

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40. Benjamin Franklin. An Account of the New Invented Pennsylvanian Fire-Places. Philadelphia, 1744.

In this pamphlet we have an excellent example of Franklin's ability to combine the theoretical with the practical. About 1740 he invented a new kind of stove designed to operate more efficiently than any of the existing methods of heating. Calling it the Pennsylvanian Fire-Place, he turned the designs over to one Robert Grace of Chester County for manufacture. This tract was written primarily to promote the sale of his invention. This advertisement follows a pattern familiar to us today. It emphasizes the use of "science" in arguing the superiority of the product.

41. Benjamin Franklin. Observations Concerning the Increase of Mankind, Peopling of Countries, &c. (Boston, 1755).

Here is yet another field into which Franklin's mind ventured. It is an effort to point out a fundamental difference in population growth between densely populated England and sparsely populated America, in part inspired by regulations passed in England restricting the development of the manufacture of iron. He concludes that as long as there is plenty of land for growth the population will increase rapidly while at the same time the cost of labor will continue to be high. Thus American manufacturers cannot constitute a threat to the British, which is based on cheap labor. This concept of the means of subsistence determining the increase of population was to be adopted a half century later by Malthus and still later by Darwin.

42. Transactions of the American Philosophical Society, Vol. I. Philadelphia, 1771.

The modern Philadelphian is hard put to find any of his eighteenth century institutions in which Benjamin Franklin did not have a hand. He was a great organizer. His best-known creation was The American Philosophical Society Held at Philadelphia for the Promotion of Useful Knowledge, our oldest learned society. As a young man Franklin gathered together groups of like-minded men for the mutual pursuit of knowledge. Out of these, he developed his idea for an intercolonial society patterned after the Royal Society. In 1743 he succeeded in forming The American Philosophical Society. However, the real life of the Society began in 1769 when it merged with The American Society Held at Philadelphia for the Promotion of Useful Knowledge. Shown here is the first volume of the Transactions of the Society issued two years later. Over half of the first issue is devoted to the transit of Venus in 1769. The subjects of other contributions range from seeds to canals.

43. Benjamin Franklin. "Maritime Observations," in Transactions of the American Philosophical Society, Vol. II. Philadelphia, 1786.

Although Franklin was the founder of the American Philosophical Society, it was not until this, the second volume of the Transactions, that we find any signed contributions by him. We have opened the book to Franklin's "Maritime Observations," the most notable feature of which is his discourse on the Gulf Stream. As early as 1768, Franklin became interested in the great "River in the Ocean" when he received a description of it from a distant relative, Timothy Folger, a whaling captain from Nantucket. During two Atlantic crossings, one from England in 1775 and the other from France in 1785, he continued his studies and finally he published here his results. His particular contribution was the use of the Fahrenheit thermometer in identifying ocean currents.

44. Essays upon the making of Salt-Petre and Gun-Powder. New York, 1776.

One of the most immediate demands the American Revolution made upon American scientists was for the manufacture of saltpetre and the refining of sulphur, the two fundamental ingredients of gunpowder. Directions for the manufacture were issued by the Continental Congress in 1775. Shown here is a similar book of instructions issued by the New York Committee of Safety in 1776.

45. John Jones. Plain Concise Practical Remarks on the Treatment of Wounds and Fractures. Philadelphia, 1776.

This is the first surgical textbook written and published in the North American colonies. It was intended as a guide for Army doctors in the American Revolution. The author, a New Yorker who was one of the country's leading surgeons, played an important part in organizing the medical department of the Continental Army. Shown here is the second edition of the book. The first appeared a year earlier in New York.

46. Benjamin Rush. Directions for preserving the Health of Soldiers. Philadelphia, 1778.

Here we have a work by one of the most colorful figures in late eighteenth century American science. Dr. Benjamin Rush, a signer of the Declaration of Independence, was primarily a physician yet his first post was that of professor of chemistry in the College of Philadelphia. His other interests included hygiene, temperance, the American Revolution, medical care of the poor, prison reform, education, and the abolition of both capital punishment and slavery. His vivid literary style and his great energy made him the best known American doctor of his day. The pamphlet shown here is his contribution to the Revolution. It was first published in a newspaper in 1777, and was a part of his efforts to reform the medical department of the army. It was an effort that failed, and he ultimately resigned from his post as surgeon general for the Middle States.

47. Memoirs of the American Academy of Arts and Sciences, Vol. I. Boston, 1785.

The second American learned society was the product of the energy and vision of John Adams. In March of 1776, he had introduced in the Continental Congress a recommendation that each colony establish "a society for the improvement of agriculture, arts, manufactures, and commerce." Later he resolved that Boston, too, should have its own society, and in the middle of the Revolution the American Academy of Arts and Sciences was incorporated by the legislature of Massachusetts. Shown here is the first volume of its Memoirs, published five years later. It contains contributions by James Bowdoin, the first president; John Winthrop; and Benjamin West, who the next year became professor of mathematics at Brown University. The volume is opened to a plate showing a newly invented pump for a fire engine. Like its

Philadelphia counterpart, the Academy was as concerned with the practical application of knowledge as with its pursuits.

Loaned by the John Hay Library

48. Jedidiah Morse. The American Geography. Elizabethtown, 1789.

One of the first needs of the new nation was a native learned literature. This is the first American geography designed for the citizens of the United States of America.

49. Thomas Jefferson. Notes on the State of Virginia. (Paris, 1785).

This classic in the literature of American natural history had its beginning in a familiar device, the questionnaire. The French government wanted to know more about the new nation she had allied herself with. A list of questions was sent to various states. The Virginia one went to Governor Thomas Jefferson. He took the twenty-two queries, which dealt primarily with economic and political matters, and rearranged them so that a greater emphasis was placed on natural history. Most of the book was written in 1781 and 1782, but it remained unpublished until he took the manuscript to France in 1785. There he had two hundred copies printed for private distribution. Jefferson wanted the reaction of his friends to the work before it was actually published. The copy shown here was given to William Short, his secretary. Almost at once there was a demand for the book, and it soon was republished in London and Philadelphia and also translated into French and German. From Jefferson the world received a vivid picture of the new nation. He was particularly anxious to show the superiority of things American. The book is opened to a drawing of the Grand Caverns, which he endeavored to name after his friend James Madison.

50. Nicholas Collin. "An Essay on those inquiries in Natural Philosophy which are most beneficial to the United States of North America," in Transactions of the American Philosophical Society, Vol. III. Philadelphia, 1793.

By the time this, the third volume of the Transactions of the American Philosophical Society, was published, the United States had achieved its independence and adopted its constitution. The Society included men like John Adams, Edmund Randolph, and Alexander Hamilton. Among the officers were David Rittenhouse, president; Thomas Jefferson, vice president; and Benjamin Rush, counselor. Four years before another counselor, Nicholas Collin, had prepared for the Society a statement of its position in the new nation. Shown here is the opening paragraph of that statement. He went on to discuss in detail the needs of the country under five heads: medical enquiries, rural economy, physicomathematical enquiries, natural history, and meteorology.

51. The Husband-man's Guide. Boston, 1710.

The earliest practice of medicine in this country was drawn from a series of books on home remedies, most of which were of English origin. Shown here, however, is the first American book to contain guides for home remedies. The second part, "Choice Physical Receipts for divers dangerous Distempers in Men, Women and Children," was probably the earliest strictly American thing of its kind. The Library owns this and the later Boston, 1712, edition of the book, probably the only known copies.

52. Cotton Mather. The Angel of Bethesda. New London, 1722.

It is not generally realized that Cotton Mather almost became a doctor. During his years at Harvard, he read extensively in the medical literature of the time. He abandoned medicine as a profession, but it was always his second interest. Out of this interest grew his The Angel of Bethesda, An Essay upon the Common Maladies of Mankind, the first general medical treatise to be written in North America. It is particularly distinctive in that it contains the first statement in America that disease could be caused by minute animals. Mather began his work about 1720 and finished it about 1724. However, no more than one chapter was ever published, the one printed in this pamphlet. As a result the true importance of Mather's medical knowledge has been obscured. Fortunately the original manuscript has survived in the American Antiquarian Society.

Inoculation in Boston

53. Increase Mather. Several Reasons Proving that Inoculating or Transplanting in the Small Pox is a Lawful Practice... Blessed by God for the Saving of many a Life. Boston, 1721.

54. Increase Mather. Some Further Account from London, of the Small-Pox Inoculated. The Second Edition, Boston, 1721.

55. Zabdiel Boylstone. Some Account of what is said of Inoculating or Transplanting the Small Pox. Boston, 1721.

56. Benjamin Colman. Some Observations on the New Method of Receiving the Small-Pox... Boston, 1721.

57. (William Cooper). A Letter to A Friend in the Country, Attempting a Solution of the Scruples and Objections... against the New Way of receiving the Small-Pox. Boston, 1721.

58. A Vindication of the Ministers of Boston from the Abuses and Scandals, lately cast upon them in Divers Printed Papers. Boston, 1722.

In this group of publications we have an American paradox in medical history. The point at issue was whether it was proper to inoculate against smallpox during the New England epidemic of 1721 and 1722. It revolved primarily around the question of whether man should tamper with the works of God. The Mathers persuaded Zabdiel Boylston, a practioner of "physick" who had no medical degree, to administer the treatment. Their opponents were led by William Douglass, the only man in the colony with a medical degree. The dispute became so heated that it found its way into the *Transactions of the Royal Society*. Finally the strange picture of leading New England divines supporting a medical practice that flew in the face of accepted theological doctrine exerted an influence in Old England. Recent study has suggested that the real point of the story is not so much science versus religion as the great power of the New England clergy to shape men's thinking. The Mathers' belief in inoculation actually rested on no sounder basis than their belief in witches. In this case, however, they happened to be right.

59. John Tennent. An Epistle to Dr. Richard Mead, Concerning the Epidemical Diseases of Virginia, Edinburgh, 1738.

This medical monograph is particularly interesting because it is part of the early controversy concerning the use of snakeroot to cure pulmonary diseases. The author, a Virginia physician, spent most of his life fighting for recognition of his cure.

60. Benjamin Franklin. Some Account of the Pennsylvania Hospital. Philadelphia, 1754.

"About the end of the year 1750 some persons who had frequent opportunities of observing the distress of such distempered poor as from time to time came to Philadelphia for the advice and assistance of the physicians and surgeons of that city. . . ," thus it was that Franklin opened his description of the genesis of the first and oldest hospital in the original thirteen colonies. Led by Dr. Thomas Bond, the large number of able doctors gathered in Philadelphia in the early part of the eighteenth century proposed the formation of a hospital. Bond sought Franklin's help with the proposal, and Franklin in turn persuaded the General Assembly to appropriate two thousand pounds if a similar amount was raised by subscription. This modern money-raising device was highly successful. Franklin wrote his account of the early beginnings of the institution the year prior to the erection of the new hospital building, which still stands in Philadelphia, the oldest building designed as a hospital in continuous use.

61. Charter for Establishing an Hospital in the City of New-York. New York, 1771.

The second hospital in British North America was a victim of the American Revolution. The hospital of the City of New York, the charter of which is shown here, was an outgrowth of the King's College Medical School (Columbia University) which had been established in 1767. One of the early faculty members, Samuel Bard, proposed the establishment of a hospital for further training. The foundation of the building was laid in 1773, but before completion it was destroyed by fire. The re-erected building, which was completed in 1776, was at once taken over by the government as a barracks, and

it continued to serve military purposes, British and American, throughout the Revolution. It was not until 1791 that it finally began to perform its intended function.

62. "An Act to make Provision for the Support and Maintenance of Ideots, Lunatics and other Persons of unsound minds," in Acts of the General Assembly (of Virginia). Williamsburg, 1770.

This is an act establishing the first hospital in the British colonies devoted exclusively to the care of the insane. Although the Pennsylvania hospital had a section for the insane, Francis Fauquier, Governor of Virginia, felt strongly that the mentally deranged of the colony should receive special care and urged the establishment of a hospital for them. The new institution received its first patient in 1773.

63. Constituciones para el nuevo Hospital de Caridad, construido en la Ciudad de Nueva Orleans. Madrid, 1793.

The first hospital to be established in what is now the United States was founded in New Orleans in 1736. It was followed by a second one in 1743, but the hurricane of 1779 destroyed most of the facilities. In 1785, what is today known as the Charity Hospital of New Orleans was built, and in 1793 it was chartered. The constitution of the hospital is shown here.

64. John Moultrie. Dissertatio Medica Inauguralis de Febre maligna biliosa Americae. Edinburgh, 1749.

Yellow fever, probably a disease of American origin, was first described by an American in this dissertation presented by John Moultrie, Jr. of Charleston. Its priority has only been recently recognized, but at the time of its publication a professor at Jena pronounced it the best account of the disease. Moultrie, the son of Charleston's leading physician, followed the pattern of many American doctors by taking his medical work at Edinburgh rather than in London. The printed dissertation, which was part of the requirements, was copied by the American medical schools, and this Library has a fine representative selection of the ones presented during the eighteenth century.

65. John Morgan. A Discourse upon the Institution of Medical Schools in America. Philadelphia, 1765.

Formal medical education in the United States began with this little book. John Morgan, one of the most successful Americans to attend medical school in Edinburgh, returned to advocate the founding of a similar school in his native Philadelphia. In 1765, he became the first professor of theory and practice of physic of the medical school at the College of Philadelphia, now the University of Pennsylvania. Morgan went on to become the director-general of hospitals and physician-in-chief of the American army in 1775. Like many other doctors in the American Revolution, he became embittered and ultimately resigned.

Loaned by Mr. Albert E. Lownes, of Providence

66. James Tilton. Dissertatio Medica. Philadelphia, 1771.

This is the inaugural dissertation of James Tilton, one of the first graduates of the University of Pennsylvania Medical School. It followed the form of the Edinburgh dissertations, another example of the strong Scottish influence in medical education. Tilton went on to become a surgeon in the American Revolution and in the War of 1812 was surgeon-general of the army.

Loaned by Mr. Albert E. Lownes, of Providence

67. William Cullen. Lectures on the Materia Medica. Philadelphia, 1775.

Dr. William Cullen and the medical school of the University of Edinburgh played major roles in the development of American medicine and medical education. Between 1758 and 1788, sixty-three Americans attended medical lectures at that Scottish university. For these students the most inspiring and influential teacher was Cullen. Shown here is the first American edition of his lectures. It was first published in 1771 from student notes, and this is a reprint of that edition.

68. The Charter, Constitution and Bye Laws of the College of Physicians of Philadelphia. Philadelphia, 1790.

The College of Physicians of Philadelphia is neither the first medical society (there were nine earlier ones) nor the oldest (there are at least three older ones). All of the older ones, however, are local in their orientation. The College of Physicians, on the other hand, set out to be for American medicine what the American Philosophical Society was for American science. Shown here is the charter of the College which was founded in 1787 by the leading physicians of Philadelphia, among them Benjamin Rush, John Morgan, and the first president, John Redman. It was modeled after the Colleges of Physicians at London and Edinburgh and was designed to achieve comparable presitge and dignity.

Perkins' Patent Tractors

69. Letters Patent issued to Elisha Perkins for his metallic tractors, February 19, 1796. Blank form, printed on vellum, filled in and signed by George Washington.

70. Description of the metallic tractors by Elisha Perkins. Manuscript on vellum.

71. Manuscript receipt issued to Elisha Perkins for patent fee dated 26, January, 1796.

The outstanding American medical nostrum of the late eighteenth century was a pair of metal instruments, called tractors, invented by Elisha Perkins of Norwich, Connecticut.

They were meant to cure disease by being drawn or stroked over the diseased parts of the body. Perkins, the son of an eminent physician, demonstrated his invention in Philadelphia during 1795 and 1796 and was awarded a patent for it, the original of which signed by President Washington, is shown here. Inserted in the upper corner are two of the tractors. Although later expelled from the Connecticut Medical Society, Perkins and his son, Benjamin, went on to exploit the device with a good deal of success in America, England and Denmark. The original documents have been loaned through the courtesy of Dr. John D. Perkins of Conshohocken, Pennsylvania, a direct descendant of the inventor. The family, which has an uninterrupted medical tradition of over two hundred years, quickly reverted to more conventional medical practices.

72. Certificates of the Efficacy of Doctor Perkin's Patent Metallic Instruments. Philadelphia, (1796?)

73. Evidences of the Efficacy of Doctor Perkin's Patent Metallic Instruments. Philadelphia, 1797.

These are but two of the eleven advertisements for the Perkins' Patent Tractor, published in 1796 and 1797.

The Yellow Fever of 1793

"The most appalling collective diaster that had ever overtaken an American city" is the description recently given to the great yellow fever epidemic Philadelphia suffered in 1793. More than half of the homes were deserted and although the total number of deaths was never computed, it was probably in excess of five thousand, twice the annual birthrate of the city. Shown in this case is a small part of the extensive literature on yellow fever that began with this plague. The years 1793 to 1805, are generally regarded as the great period of the disease's malignancy as it repeated itself in Philadelphia almost annually and later spread over the country and across to Europe. It was not until 1902, when Walter Reed identified a mosquito as the villain in the case, that it was controlled. The 1793 epidemic has held particular fascination for American novelists from Charles Brockden Brown's Arthur Mervyn, 1799, to Janet Whitney's Judith, 1943.

74. Minutes of the Proceedings of the Committee Appointed on the 14th September, 1793, By the Citizens of Philadelphia. . . to Attend to and Alleviate the Sufferings of the Afflicted with the Malignant Fever. Philadelphia, 1794.

This document is a report of the special committee created to cope with the disaster. Its principal duties consisted of raising money and administering Bush Hill, the principal hospital to which victims were sent.

75. J. Heinrich C. Helmuth. Kurze Nachricht von den Sogenannten gelben Fieber in Philadelphia. Philadelphia, 1793.

This is an account by the pastor of the Lutheran Church, one of the courageous clergymen who stayed in the city and cared for their congregations.

76. Mathew Carey. A Short Account of the Malignant Fever. Philadelphia, 1793.

This extraordinarily popular account of the disaster by Philadelphia's most promising printer was issued just a month after the cool weather brought an end to the epidemic.

77. Benjamin Rush. An Account of the Bilious remitting Yellow Fever. Philadelphia, 1794.

The greatest single figure in the epidemic of 1793 was Dr. Benjamin Rush. He dominated the medical scene, and he regarded his cure, which consisted of bleeding and purging, as the major achievement of his career. This is his account, published in the following year.

78. Jean Deveze. An Enquiry into, and Observations upon the Causes and Effects of the Epidemic Disease, in Select Pamphlets respecting the Yellow Fever. Philadelphia, 1794.

This is an account of the plague by a French doctor and refugee from Santo Domingo. His treatment was radically different from Rush's. He together with Stephen Girard, a Philadelphia merchant, served as the managers of Bush Hill, the yellow fever hospital.

79. John Haygarth. An Inquiry How to prevent the Small-Pox. Chester, 1784.

The story of American medicine opens in the eighteenth century with the problem of smallpox. The Mathers' support of the treatment, although correct, was based on a non-scientific premise. It is significant, therefore, that the eighteenth century should also close with the problem of smallpox but with the cure scientifically supported by another New Englander, Benjamin Waterhouse. Shown here is his earliest published statement on smallpox. It is a letter written in 1778 to an English physician, published in Chester, describing the success of the quarantine at Newport by which smallpox had been effectively kept out of the town.

80. Benjamin Waterhouse. A Prospect of exterminating the Small Pox, Part II. Cambridge, 1802.

This is the second part of Waterhouse's great study of the question of inoculation. It is dedicated to Edward Jenner, the English physician who finally made his preventive treatment generally accepted.

Loaned by the John Hay Library

SCIENCE IN PROVIDENCE

81. Benjamin Waterhouse. Heads of a Course of Lectures intended as an Introduction to Natural History. Providence, 1788. (?)

Although Waterhouse's name is associated with Boston and Harvard, he began the American part of his scientific career in Providence and Rhode Island College. Born in Newport, trained in England, Scotland, and Holland, he returned to this country at the end of the Revolution and took up an appointment as professor of natural history at the college, the first such professorship in this country. When he first moved to Harvard, he continued his post in Providence and returned to give the course of lectures described in this broadside. Apparently the lectures were opened to the public as well as students of the college, and the fees charged helped to pay his salary.

Loaned by the Rhode Island Historical Society

82. Henry Moyes. Heads of a Course of Lectures on the Philosophy of Chemistry and Natural History. Boston, 1784.

One of the most fascinating figures in the popularization of science in America was Dr. Henry Moyes of Edinburgh, Scotland, a blind scientist who lectured up and down the Atlantic Coast from Boston to Charleston. He drew large audiences, sometimes as many as twelve hundred people. Shown here is a pamphlet listing the scientific fields covered by Dr. Moyes in lectures he gave in Providence in 1784.

83. Solomon Drowne. Diary. Manuscript of 1772.

Most of what we know about scientific education at Brown University in its earliest years is to be found in the diary of Solomon Drowne, who graduated in 1773 and later became a physician. This volume of the diary is opened to the page in which he described work with Mr. Joseph Brown's philosophical apparatus. He mentions carrying a telescope, which is shown in this exhibition, up the hill to look at the sun, moon, and stars.

Loaned by the Solomon Drowne Collection, John Hay Library

84. Peres Fobes. A Course of Lectures upon Natural Philosophy and Astronomy. Providence, 1790.

The Reverend Peres Fobes was professor of natural philosophy at Rhode Island College in 1786. This broadside is an announcement of one of his courses of public lectures. These popular discourses played an important role in acquainting Providence with developments in science.

85. Benjamin West. An account of the observation of Venus upon the sun. Providence, 1769.

The results of the Providence observation of the transit of Venus were published in this little book by Benjamin West. The copy on the left, opened to the title page, was actually owned by Joseph Brown, the owner of the telescope. The one on the right is opened to the diagram of the transit itself. This appears to have been the first separately published account of the 1769 transit, which had also been observed in other American cities including Boston, Newport, and Philadelphia.

86. Joseph Brown's Gregorian Telescope, Four-Inch Aperture, Twenty-four-Inch Focal Length, made in London about 1769 by Watkins and Smith.

Venus's passing between the sun and the earth occurs in pairs about one hundred years apart. Kepler pointed out that an accurate observation of this event in a number of different places would make it possible to calculate linear distances in the solar system. The transits of Venus of 1631 and 1639 were obscured. Therefore, the scientific world awaited eagerly the two transits of 1761 and 1769, and it took on some of the aspects of an early International Geophysical Year. John Winthrop of Harvard led an expedition to Newfoundland to observe the transit of 1761. Inspired by this, Joseph Brown, a Providence merchant, ordered from England the telescope shown here so that Providence could participate in the transit of 1769. Together with Benjamin West, later the first professor of mathematics at Brown University, he and a group of distinguished Providence citizens conducted the observation from a platform, one hundred feet east of Benefit Street. The street on which the platform was located was later named Transit Street in honor of the event. The fact that Providence was able to participate in this international scientific event was, in the eyes of many of its citizens, an important measure of the stature and eminence of the city.

Loaned by the Ladd Observatory, Brown University

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EARLY GENERAL SCIENCE

87. Alonso de la Veracruz. Phisica Speculatio. Mexico, 1557.

This is the earliest work of physical science to be composed and printed in the new World. Veracruz came to Mexico in 1536 and occupied the first chair of scholastic theology at the University of Mexico in 1553. He was responsible for the first works of a purely cultural character to be published in America.

88. William Gilbert. De Magnete. London, 1600.

This fundamental work by a man who is claimed as the founder of the science of electricity is the foundation from which the whole exciting story of Franklin and his electrical experiments grew.

Loaned by Mr. Albert E. Lownes, of Providence

89. Johann Kepler. Tabulae Rudolphinae. (Ulm, 1627).

Johann Kepler presented the world with a geometrical plan of the solar system, basing his work on Copernicus and Tycho Brahe, his predecessor in the observatory near Prague. He became a major figure in the history of astronomy. Shown here are the Rudolphian tables begun by Brahe and completed by Kepler in which are given the various relative distances in the solar system. They retained their authority for over a century and have never, in principle, been superseded. They are of particular interest to us because until the observation of the transit of Venus in 1761 and 1769 mankind only knew the relative distances between planets.

90. Edward Wright. Certaine Errors in Navigation...detected and corrected. London, 1599.

The science of navigation, the development of which is closely related to the whole era of exploration and discovery, was notably advanced by this book. Here, the author, a British mathematician, describes to his countrymen the important Mercator projection, which had been developed some thirty years earlier.

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